

# **ENERGY EFFICIENCY/RENEWABLE ENERGY IMPACT IN THE TEXAS EMISSIONS REDUCTION PLAN (TERP)**

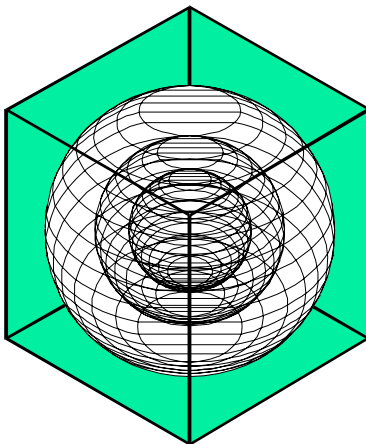
## **VOLUME I – SUMMARY REPORT**

**Annual Report to the  
Texas Commission on Environmental Quality  
September 2004 – December 2005**



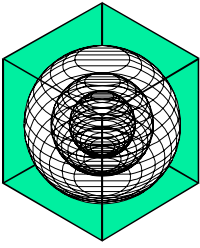
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June 2006  
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## **ENERGY SYSTEMS LABORATORY**

**Texas Engineering Experiment Station  
Texas A&M University System**



**ENERGY SYSTEMS LABORATORY**  
Texas Engineering Experiment Station  
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September 12, 2006

Chairman Kathleen Hartnett White  
Texas Council on Environmental Quality  
P. O. Box 13087  
Austin, TX 78711-3087

Dear Chairman White:

The Energy Systems Laboratory (ESL) at the Texas Engineering Experiment Station of the Texas A&M University System is pleased to provide its fourth annual report, "Energy Efficiency/Renewable Energy Impact in the Texas Emissions Reduction Plan (TERP)," as required under Texas Health and Safety Code Ann. § 388.003 (e), Vernon Supp. 2002 (Senate Bill 5, 77R as amended 78 R & 78S).

The ESL is required to annually report the energy savings from statewide adoption of the Texas Building Energy Performance Standards in Senate Bill 5 (SB 5), as amended, and the relative impact of proposed local energy code amendments in the 41 Texas non-attainment and affected counties as part of the Texas Emissions Reduction Plan (TERP).

Please contact me at (979) 862-8480 should you or any of the TCEQ staff have any questions concerning this report or any of the work presently being done to quantify emissions reductions from energy efficiency and renewable energy measures as a result of the TERP implementation.

Sincerely,

W. Dan Turner, P.E.  
Director

Enclosure

cc: Commissioner R. B. "Ralph" Marquez  
Glenn Shankle, Executive Director

### **Disclaimer**

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## **VOLUME I – SUMMARY REPORT**

### **Energy Efficiency/Renewable Energy Impact In The Texas Emissions Reduction Plan**

#### **Executive Summary**

The Energy Systems Laboratory, in fulfillment of its responsibilities under Texas Health and Safety Code Ann. § 388.003 (e), Vernon Supp. 2002, submits its fourth annual report, Energy Efficiency/Renewable Energy (EE/RE) Impact in the Texas Emissions Reduction Plan to the Texas Commission on Environmental Quality.

The report is organized in three volumes.

Volume 1 – Summary Report – provides an executive summary;

Volume II – Technical Report – provides a detailed report of activities, methodologies and findings;

Volume III – Technical Appendix – contains detailed data from simulations for each of the 41 counties included in the analysis.

#### **Legislative Background**

In 2001, the Texas Emissions Reduction Plan (TERP), established by the 77<sup>th</sup> Texas Legislature with the enactment of Senate Bill 5 (SB 5), identified that Energy Efficiency and Renewable Energy (EE/RE) measures make an important contribution to a comprehensive approach for meeting the minimum federal ambient air quality standards. In 2003 and 2005, the 78<sup>th</sup> and 79<sup>th</sup> Legislatures enhanced the use of EE/RE programs for meeting the TERP. The 78<sup>th</sup> Legislature enhanced the use of EE/RE programs for meeting TERP goals by requiring the Texas Commission on Environmental Quality (TCEQ) to promote EE/RE as a means to improve air quality standards and to develop a methodology for computing emissions reduction for the State Implementation Plan (SIP) from EE/RE programs. The 79<sup>th</sup> Legislature again expanded the scope of the SIP-eligible credits by adding savings from the State Renewable Portfolio Standards from the generation of electricity from renewable sources; specifically requiring the TCEQ to develop methods to quantify emissions reductions from renewable energy; and requiring the Energy Systems Laboratory to develop at least 3 alternative methods for achieving a 15 percent greater potential energy savings in residential, commercial and industrial construction.

#### **NO<sub>x</sub> Emissions Reductions**

The TERP legislation adopted the energy efficiency provisions of the International Residential Code (IRC) and the International Energy Conservation Code (IECC) for residential, commercial and industrial buildings. Under the TERP legislation, the Energy Systems Laboratory (Laboratory) at the Texas Engineering Experiment Station of the Texas A&M University System must determine the energy savings from energy code

adoption and, when applicable, from more stringent local codes or above-code performance ratings and must report these reductions annually to the TCEQ.

Using data available from the TCEQ and the U.S. Environmental Protection Agency (US EPA) with procedures developed by the Laboratory, the following results were determined for energy-code compliant new residential single- and multi-family construction in non-attainment and affected counties built in 2004:

- The annual savings in 2005 amounted to 348,794 megawatt hours (MWh) of electricity and 690,579 million Btus of natural gas. The resultant annual NOx reductions were 268 tons (2007 eGRID<sup>1, 2</sup>).
- On the peak Ozone Season Day (OSD), the savings would have been 1,799 MWh/day and 1,210 million Btu (MBtu) of natural gas, resulting in peak-OSD NOx emissions reductions of 1.26 tons (2007 eGRID).
- Beginning in 2005, the Laboratory worked with the TCEQ to integrate NOx emissions reductions (iNOxERM) across state agencies implementing EE/RE programs to that the results can be evaluated consistently. As required by the legislation, the TCEQ receives reports: from the Laboratory on savings from code compliance and renewables; from the Public Utilities Commission of Texas (PUCT) on the impacts of the utility-administered programs designed to meet the mandated energy efficiency goals of SB7 and SB5; and from the State Energy Conservation Office (SECO) on the impacts of energy conservation in state agencies and political subdivisions. The Laboratory has also requested data about electricity generated from wind turbines from the Electric Reliability Council of Texas (ERCOT).

Total cumulative, integrated NOx reductions from these programs were determined to be 5,711.58 tons/year, and 15.43 tons/peak-OSD in 2009, and 6,034.93 tons/year and 17.14 tons/peak-OSD in 2013, which contain the following contributions from the Laboratory, PUCT, SECO, and green power provided by wind turbine<sup>3</sup> renewable energy sources (i.e., ERCOT) programs:

- energy efficiency savings from code-compliant new construction: 900.52 tons/year, and 4.47 tons/peak-OSD in 2009; and 1,167.49 tons/year with 5.75 tons/peak-OSD in 2013 (2007 eGRID);
- the PUCT-SB 7 and SB 5 programs: 1,483.22 tons/year, and 3.98 tons/peak-OSD in 2009, and 1,981.05 tons/year, and 5.31 tons/peak-OSD in 2013 (2007 eGRID);
- the SECO program, 447.10 tons/year, and 1.29 tons/OSD in 2009, and 699.86 tons/year, and 1.76 tons/peak-OSD in 2013; and

<sup>1</sup> eGRID, is the EPA's emissions and generation resource integrated database. This publicly available database can be found at [www.epa.gov/airmarkets/eGRID/](http://www.epa.gov/airmarkets/eGRID/). In this report the 2007 version of eGRID was used. This eGRID was specially created for Texas by Art Diem at the USEPA, and includes specific assumptions about plant closures, new plant additions, and capacity factor for annual and Ozone Season Day (OSD) periods that are projected to occur in 2007.

<sup>2</sup> The 2007 version of eGRID used in this report does not consider the coal-fired electricity generating plants proposed by TXU in the Spring of 2006.

<sup>3</sup> The green power provided by wind turbine installations is currently monitored by the Electric Reliability Council of Texas (ERCOT).

- the Wind/ERCOT program: 2,880.74 tons/year and 5.69 tons/peak-OSD in 2009 and 2,186.33 tons/year and 4.32 tons/peak-OSD in 2013.

## Energy Code Amendments

The Laboratory was requested to analyze the stringency of several residential and commercial energy codes, including: the 2003 and 2006 IECC, and ASHRAE Standard<sup>4</sup> 90.1-2004 (i.e., commercial buildings), ASHRAE Standard<sup>5</sup> 90.2-2004 (i.e., residential buildings). ASHRAE Standard 90.2-2004 was found to be more stringent for fenestration U-values, external shading and Domestic Hot Water (DHW), and less stringent in geometry and orientation, slab-on-grade construction for Heating Degree Days (HDD) HDD > 2400, total fenestration losses and ceiling attic U-values. ASHRAE Standard 90.2-2004 also had conflicting requirements regarding performance evaluations of ceilings, walls and ducts. The 2006 IECC was found to be less stringent for many of the 41 counties in Texas when compared to the current residential code (i.e., the 2000 IECC with 2001 Supplement). ASHRAE Standard 90.1-2004 was found to be more stringent than ASHRAE Standard 90.1-1999, which is mostly due to reductions in allowed lighting power levels.

## Technical Assistance

The Laboratory provided technical assistance to the TCEQ, PUCT, SECO and ERCOT, as well as Stakeholders participating in the Energy Code and Renewables programs. In 2005, the Laboratory worked closely with the TCEQ to develop an integrated NOx emissions reduction (iNOxERM) calculation that provided the TCEQ with a creditable NOx emissions reduction from energy efficiency and renewable energy (EE/RE) programs reported to the TCEQ in 2005 by the Laboratory, PUCT, SECO, and ERCOT (i.e., wind)<sup>6</sup>. At the request of the TCEQ, the Laboratory also developed procedures for quantifying NOx emissions reductions from wind turbines that include weather normalization<sup>7</sup>, and quantification of NOx emissions reductions from pilot lights attributable to residential furnace replacements and potential reductions from the elimination of standing pilot lights in domestic water heaters. At the request of the Dallas-Fort Worth International Airport, the Laboratory developed quantifications of NOx emissions reductions from energy-efficiency improvements at the Rent-a-Car facility at the Dallas – Fort Worth (DFW) DFW Airport.

<sup>4</sup> ASHRAE Standard 90.1 - 2004, Energy Standard for Buildings Except Low-rise Residential Buildings, American Society of Heating Refrigerating and Air-conditioning Engineers, Atlanta, GA.

<sup>5</sup> ASHRAE Standard 90.2 - 2004, Energy - Efficient Design for Low-Rise Residential Buildings, American Society of Heating Refrigerating and Air-conditioning Engineers, Atlanta, GA. Although Standard 90.2 is not currently referenced by the 2000/2001 IECC, in 2005, efforts were initiated by ASHRAE to make Standard 90.2 equivalent to the IECC. Hence, the Laboratory was required to review Standard 90.2 to determine if it was more/less stringent than the 2000/2001 IECC.

<sup>6</sup> In 2005 the Texas State Energy Conservation Office (SECO) requested technical assistance from the USDOE, through the National Renewable Energy Laboratory (NREL), to review the procedures used in TCEQ's integrated NOx emissions reductions calculations. Although preliminary results indicated a favorable finding, a final report has not been delivered by NREL.

<sup>7</sup> The weather normalization procedures for green power purchases from wind generated electricity primarily involve normalization for wind speed to allow for electricity purchased in 2005 to be projected to the 1999 base year. Additional information about this can be found in Volume II.

The Laboratory has also enhanced the previously developed emissions reductions calculator<sup>8</sup> by: expanding the capabilities to include all counties in ERCOT; including the collection and assembly of meteorological (i.e., weather) data from 1999 to the present from 17 NOAA weather stations; expanding the calculator to be able to analyze energy efficiency improvement to K-12 schools; developing new modules for municipal water and wastewater calculations; enhancing the underlying computer platform for the calculator; and developing verification procedures for the savings currently calculated and reported by the Laboratory, including calibrated simulations for two office buildings, one residence and one K-12 school, and utility bill analysis of representative residences built before and after the implementation of the Statewide building code (i.e., 2000 IECC with 2001 Supplement)<sup>9</sup>.

## Technology Transfer

To accelerate the transfer of technology developed as part of the Senate Bill 5 program, the Laboratory:

- delivered an invited presentation to the US EPA's Air Innovations Conference in Chicago, August, 2005;
- delivered six papers at the International Conference on Enhanced Building Operations at Carnegie Mellon University in Pittsburgh, PA, in October 2005;
- hosted the Energy Leadership and Emissions Reduction and Conference in Dallas, in November 2005;
- developed an article for the *ibpsaNEWS* newsletter<sup>10</sup>; and
- published technical reports on advanced window simulations, and methods for reducing residential energy use by 50%.

The Laboratory has and will continue to provide leading edge technical assistance to the TCEQ, counties and communities working toward obtaining full SIP credit for the energy efficiency and renewable energy projects that are lowering emissions and improving the air for all Texans. The Laboratory will continue to provide superior technology to the State of Texas through efforts with the TCEQ and US EPA. The efforts taken by the Laboratory have produced significant success in bringing EE/RE closer to US EPA acceptance in the SIP.

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<sup>8</sup> In the Fall of 2003, the Laboratory formed a partnership with the Texas Commission for Environmental Quality (TCEQ) and the USEPA to enhance the Emissions Reduction Calculator. Since then, the Laboratory has worked closely with the TCEQ, using funding provided by the USEPA, to enhance the calculator, which includes the addition of two new modules for calculating energy savings from improvements to water and waste water systems. Additional information about these new modules is contained in Volume II.

<sup>9</sup> See Volume II for additional information about each of these topics.

<sup>10</sup> *ibpsaNEWS* is the electronic newsletter for the International Building Performance Simulation Association, co-sponsored by the US DOE.

## **VOLUME I – SUMMARY REPORT**

### **Energy Efficiency/Renewable Energy Impact In The Texas Emissions Reduction Plan**

#### **Overview**

The Energy Systems Laboratory (Laboratory) is pleased to provide our fourth annual report, Energy Efficiency/Renewable Energy Impact in the Texas Emissions Reduction Plan (TERP), to the Texas Commission on Environmental Quality (TCEQ) in fulfillment of its responsibilities under Texas Health and Safety Code Ann. § 388.003 (e), Vernon Supp. 2002. This annual report:

- Provides an estimate of the energy savings and NO<sub>x</sub> reductions from energy code compliance in new residential construction in 41 counties;
- Describes the technology developed to enable the TCEQ to substantiate energy and emissions reduction credits from energy efficiency and renewable energy initiatives (EE/RE) to the U.S. Environmental Protection Agency (US EPA), including the development of a web-based emissions reductions calculator; and
- Outlines progress in advancing EE/RE strategies for credit in the State Implementation Plan (SIP).

The report is organized in three volumes.

Volume I – Summary Report – provides an executive summary;

Volume II – Technical Report – provides a detailed report of activities, methodologies and findings;

Volume III – Technical Appendix – contains detailed data from simulations for each of the forty-one counties included in the analysis.

#### **Legislative Background**

The TERP was established in 2001 by the 77<sup>th</sup> Legislature through the enactment of Senate Bill 5 to:

- Ensure that Texas air meets the Federal Clean Air Act requirements (Section 707, Title 42, United States Code); and
- Reduce NO<sub>x</sub> emissions in non-attainment and affected counties through mandatory and voluntary programs, including the implementation of energy efficiency and renewable energy programs (EE/RE).



To achieve the clean air and emissions reduction goals of the TERP, SB 5 created a number of EE/RE programs for credit in the SIP:

- Adopts statewide Texas Building Energy Performance Standards (TBEPS) as the building energy code for all residential and commercial buildings;
- Provides that a municipality or county may request the Laboratory to determine the energy impact of proposed energy code changes;
- Provides for an annual evaluation by the Public Utility Commission of Texas (PUCT), in cooperation with the Laboratory, of the emissions reduction of energy demand, peak electric loads and the associated air contaminant reductions from utility-sponsored programs established under SB 5 and utility-sponsored programs established under the electric utility restructuring act (Section 39.905 Utilities Code);
- Establishes a 5% per year electricity reduction goal each year for facilities of political subdivisions in non-attainment and affected counties from 2002 through 2007; and
- Requires the Laboratory to report to the TCEQ the energy savings (and resultant emissions reduction) from implementation of building energy codes and to identify the municipalities and counties whose codes are more or less stringent than the unamended code.

The 78<sup>th</sup> Legislature (2003), through HB 1365 and HB 3235, amended TERP to enhance its effectiveness with additional energy efficiency initiatives, including:

- Requires the TCEQ to conduct outreach to non-attainment and affected counties on the benefits of implementing energy efficiency measures as a way to meet the air quality goals under the federal Clean Air Act;
- Requires the TCEQ develop a methodology for computing emissions reductions from energy efficiency initiatives;
- Authorized a voluntary Energy-Efficient Building Program at the General Land Office (GLO), in consultation with the Laboratory, for the accreditation of buildings that exceed the state energy code requirements by 15% or more;
- Authorizes municipalities to adopt an optional, alternate energy code compliance mechanism through the use of accredited energy efficiency programs determined to be code-compliant by the Laboratory, as well as the US EPA's Energy Star New Homes program; and
- Requires the Laboratory to develop and administer a statewide training program for municipal building inspectors seeking to become code-certified inspectors for enforcement of energy codes.

The 79<sup>th</sup> Legislature (2005), through SB 20, HB 2481 and HB 2129, amended SB 5 to enhance its effectiveness by adding the following additional energy efficiency initiatives:

- Requires 5,880 MW of generating capacity from renewable energy technologies by 2015;
- Includes 500 MW from non-wind renewables;

- Requires PUCT to establish a target of 10,000 megawatts of installed renewable capacity by 2025;
- Requires TCEQ to develop methodology for computing emissions reductions from renewable energy initiatives and the associated credits;
- Requires the Laboratory to assist TCEQ in quantifying emissions reductions credits from energy efficiency and renewable energy programs;
- Requires Texas Environmental Research Consortium (TERC) to contract with the Laboratory to develop and annually calculate creditable emissions reductions from wind and other renewable energy resources for the state's SIP; and
- Requires the Laboratory to develop at least three alternative methods for achieving a 15 % greater potential energy savings in residential, commercial and industrial construction.

### **Laboratory Funding for the TERP**

The Laboratory received \$182,000 in FY 2002; \$285,000 in FY 2003; \$950,421 in FY 2004; and \$952,019 in FY 2005. The Laboratory has also supplemented these funds with competitively awarded federal grants to provide the needed statewide training for the new mandatory energy codes and to provide technical assistance to cities and counties in helping them implement adoption of the legislated energy efficiency codes, and a grant from the US EPA through the TCEQ in 2005 to enhance the web-based EE/RE emissions calculator.

### **Progress in FY 2005**

Since September 2004, the Energy Systems Laboratory has accomplished the following activities in fulfillment of its responsibilities under SB 5:

- Estimated energy and resultant NOx reductions from implementation of the Texas Building Energy Performance Standards (IECC/IRC codes) to new residential and commercial construction for all non-attainment and affected counties;
- Enhanced the web-based "Emissions Reduction Calculator" for determining emissions reduction from energy efficiency improvements in residential and commercial construction, municipal projects and renewable energy projects;
- Enhanced the Laboratory's IECC/IRC Code-Traceable Test Suite for determining emissions reduction due to code and above-code programs;
- Continued development and testing of key procedures for validating simulations of building energy performance;
- Provided energy code training workshops, including: 15 residential, 12 commercial IECC/IRC energy code training sessions and 3 ASHRAE Standard 90.1 workshops throughout the State of Texas;
- Maintained and updated the Laboratory's Senate Bill 5 website;
- Maintained a builder's residential energy code Self-Certification Form (Ver.1.3) for use by builders outside municipalities;
- Responded to hundreds of phone and email inquiries on code implementation and verification issues;

- Analyzed the stringency of several residential and commercial energy codes, including ASHRAE Standard 90.2-2004, the 2003 IECC, the 2004 IECC, the 2006 IECC, and ASHRAE Standard 90.1-2004;
- Hosted the Energy Leadership and Emissions Reductions Conference, November 7-10, 2005, in Dallas. Conference sessions included key talks by TCEQ, EPA, DOE and the Laboratory about quantifying emissions reductions from EE/RE opportunities and guidance on key energy efficiency and renewable energy topics;
- Provided technical assistance to the TCEQ regarding specific issues, including:
  - Development of an integrated NO<sub>x</sub> emissions reductions (iNO<sub>x</sub>ERM) reporting procedure<sup>11</sup> to TCEQ for ESL, PUCT, SECO and ERCOT;
  - Developed a procedure for weather normalizing NO<sub>x</sub> emissions reductions from power provided by wind energy;
  - Quantified emissions reductions from retrofits at the Rent-a-Car center at the Dallas-Fort Worth International Airport;
  - Quantified emissions reductions from the elimination of pilot lights in replacement furnaces and domestic water heaters;
- Enhanced web-based emissions reduction calculator, including:
  - Expanded emissions reductions calculator to include all counties in ERCOT;
  - Gathered, cleaned and posted weather data archive for 17 NOAA stations;
  - Developed new water/wastewater design modules (w/EPA grant);
  - Developed new computer architecture to allow for synchronous calculations, user accounts, and code-compliance;
- Developed preliminary verification procedures, including:
  - Completion of calibrated simulation of high efficiency office building;
  - Worked towards a calibrated simulation of an office building;
  - Worked towards a calibrated simulation of a K-12 school;
  - Worked towards a calibrated simulation of a Habitat for Humanities residence; and
  - Developed preliminary utility bill comparison for residences.

These activities were designed to more accurately calculate the creditable NO<sub>x</sub> emissions reductions from EE/RE initiatives contained in the TERP, and to assist the TCEQ, local governments, and the building industry with effective implementation and reporting.

### **Energy and NO<sub>x</sub> Reductions from New Residential and Commercial Construction**

State adoption of the energy efficiency provisions of the International Residential Code and International Energy Conservation Code became effective September 1, 2001. The Laboratory has developed and delivered training to assist municipal inspectors to become certified energy inspectors. The Laboratory also supported code officials with guidance on interpretations as needed. This effort, based on a requirement of HB 3235, 78<sup>th</sup> Texas Legislature, supports a more uniform interpretation and application of energy codes throughout the state. In general, the State is experiencing a true market transformation

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<sup>11</sup> These procedures are currently under review by the USDOE, through the National Renewable Energy Laboratory (NREL).

from low energy efficiency products to high energy efficiency products. These include Low Solar Heat Gain windows, higher efficiency appliances, increased insulation, lower thermal loss ducts and in builder participation in “above-code” code programs such as Energy Star New Homes, which previously had no state baseline and almost no participation.

Annual energy savings<sup>12</sup> from energy code-compliant, new residential construction built in 2005 amounted to 263,656 MWh/year saved from single-family residential; 10,157 MWh/year saved from multi-family residential; 75,072 MWh/year saved from commercial construction; and 690,579 MBtu/year saved from residential and commercial construction.

In the 41 non-attainment and affected counties, the resultant *annual* NOx reductions in 2005 were calculated to be 268 tons NOx/year (2007 eGRID), which include:

- 180 tons NOx/year from single-family residential (263,656 MWh/year saved);
- 7 tons NOx/year from multi-family residential (10,157 MWh/year saved);
- 49 tons NOx/year from commercial construction (75,072 MWh/year saved); and
- 32 tons NOx/year from natural gas savings from single-family, multi-family residential and commercial construction (690,579 MBtu/year saved).

For the *peak ozone season day (OSD)*, the NOx reductions in 2005 are calculated to be 1.26 tons of NOx/peak-OSD, which represents:

- 0.88 tons NOx/day from single-family residential (1,299 MWh/day saved);
- 0.03 tons NOx/day from multi-family residential (43.05 MWh/day saved);
- 0.29 tons NOx/day from commercial (457.17 MWh/day saved); and
- 0.06 tons NOx/day from natural gas savings from single-family, multi-family and commercial construction (1,210 MBtu/day saved).

Total cumulative NOx reductions<sup>13</sup> were determined to be 5,711.58 tons/year, and 15.43 tons/peak-OSD in 2009; and 6,034.93 tons/year and 17.14 tons/peak-OSD in 2013, which contain the following contributions from the Laboratory, the Public Utilities Commission, the State Energy Conservation Office, and green power provided by wind turbines<sup>14</sup> renewable energy sources Wind/ERCOT programs:

- From energy efficiency savings from code-compliant new construction: 900.52 tons/year, and 4.47 tons/peak-OSD in 2009; and 1,167.49 tons/year with 5.75 tons/peak-OSD in 2013 (2007 eGRID);

<sup>12</sup> These annual energy savings do include 7% transmissions and distribution losses, but do not include discount or degradations factors.

<sup>13</sup> The total cumulative NOx reductions for new residential and commercial construction for the years 2005 to through 2013 include a one-time 20% discount factor and a 5% annual degradation factor, as recommended by TCEQ. Discount factors for PUC, SECO and green power purchases are 25%, 60% and 25%, respectively, also as recommended by TCEQ. All cumulative calculations used a transmission and distribution loss of 7%.

<sup>14</sup> The green power provided by wind turbine installations is currently monitored by the Electric Reliability Council of Texas (ERCOT).

- From the PUCT SB 7 and SB 5 programs: 1,483.22 tons/year, and 3.98 tons/peak-day-OSD in 2009; and 1,981.05 tons/year, and 5.31 tons/peak-OSD in 2013 (2007 eGRID);
- From the SECO program, 447.10 tons/year, and 1.29 tons/OSD in 2009; and 699.86 tons/year, and 1.76 tons/peak-OSD in 2013; and
- From the Wind/ERCOT program<sup>15</sup>: 2,880.74 tons/year and 5.69 tons/peak-OSD in 2009; and 2,186.33 tons/year and 4.32 tons/peak-OSD in 2013.

Details of the analysis are reported in Volume II of this report.

### **Technology for Calculating and Verifying Emissions Reduction from Energy Used in Buildings**

In 2004, the Laboratory developed a web-based Emissions Reduction Calculator, known as “*eCalc*,” which contains the underlying technology for determining emissions reductions from power plants that generate the electricity for the user. The Emissions Reduction Calculator is being used to calculate emissions reductions for consideration for SIP credits from energy efficiency programs in the TERP. The TCEQ and the US EPA are currently reviewing the Laboratory’s proposed technology and recent refinements for estimating NO<sub>x</sub> emissions reductions from additional energy efficiency and renewable energy (EE/RE) measures.

In 2005, the Laboratory enhanced the calculator to provide additional functions and usability. This enhanced engineering analysis software addressed major challenges:

- How to quantify and validate the persistence of energy savings from EE/RE energy measures;
- How to transform electricity reductions into spatial (location) and temporal (time-of-day) distributions of emissions reductions from electric utility power plants;
- How to quantify cumulative multi-year emissions reductions that account for reduced emissions from the associated power plants according to the US EPA’s eGRID database using the specially prepared 2007 version of eGRID; and
- How to weather-normalize NO<sub>x</sub> emissions estimates for renewable sources, such as wind and solar.

In 2005, the Laboratory’s Emissions Reduction Calculator used a specially prepared 2007 version of the US EPA’s eGRID database to identify where emissions are produced. The Laboratory has also enhanced the previously developed emissions calculator by:

- Expanding the capabilities to include all counties in ERCOT; including the collection and assembly of weather from 1999 to the present from 17 NOAA weather stations;

<sup>15</sup> The results for this 2005 report include findings from the preliminary wind analysis performed for the TCEQ using 2005 data provided by ERCOT. As part of the Laboratory’s legislative 2005/2006 work a new, more accurate weather-normalization procedures are being developed to improve the NO<sub>x</sub> emissions reductions estimates. Additional information about the new procedures is provided in Volume II.

- Expanding the calculator to be able to analyze energy efficiency improvement to K-12 schools;
- Developing new modules for municipal water and waste-water calculations;
- Enhancing the underlying computer platform for the calculator; and
- Developing verification procedures for the savings currently calculated and reported by the Laboratory, including calibrated simulations for a two office buildings, a residence and one K-12 school, and utility bill analysis of representative residences built before and after the implementation of the State-wide building code.

### **Evaluation of Additional Technologies for Reducing Energy Use in Existing Buildings**

The Laboratory provided technical assistance to the TCEQ, the PUCT, SECO and ERCOT, as well as Stakeholders participating in the Energy Code and Renewables programs.

- In 2005, the Laboratory worked closely with the TCEQ to develop an integrated NOx emissions reductions (iNOxERM) calculation that provided the TCEQ with a creditable NOx emissions reductions from energy efficiency and renewable energy (EE/RE) programs reported to the TCEQ in 2005 by the Laboratory, PUCT, SECO, and ERCOT (i.e., wind);
- At the request of the TCEQ, the Laboratory also developed procedures for quantifying NOx emissions reductions from wind turbines that includes weather normalization and the quantification of NOx emissions reductions from pilot lights attributable to residential furnace replacements, and potential reductions from the elimination of standing pilot lights in domestic water heaters; and
- At the request of the Dallas-Fort Worth International Airport, the Laboratory developed quantifications of NOx emissions reductions from energy efficiency improvements at the Rent-a-Car facility at the DFW Airport.

### **Planned Focus for 2006/2007**

In FY 2006, the Energy Systems Laboratory is continuing its cooperative efforts with the TCEQ, PUCT, SECO, US EPA and others to ensure EE/RE measures remain a cost-effective solution to clean air, and continue to support the energy efficiency and renewable energy opportunities of the TERP. The Laboratory team will:

- Assist the TCEQ to obtain SIP credits from energy efficiency and renewable energy using the Laboratory's Emissions Reduction Calculator technology;
- Verify, document and report energy efficiency and renewable energy savings in all TERP EE/RE programs for the SIP in each non-attainment and affected county using the TCEQ/US EPA approved technology;
- Assist the PUCT with determining emissions reductions credits from energy efficiency programs funded by SB 7 and SB 5;

- Assist political subdivisions and Councils of Governments with calculating emissions reductions from local code changes and voluntary EE/RE programs for SIP inclusion;
- Develop low-cost methods and techniques to implement 15% above code energy efficiency in low-priced and moderately-priced residential housing;
- Continue to develop creditable procedures for calculating NOx emissions reductions from green renewable technologies, including wind power, solar energy and geothermal energy systems;
- Continue development of well-documented, iNOxERM methodologies for calculating and reporting NOx reductions, including a unified database framework for required reporting to TCEQ of potentially creditable measures from the ESL, PUCT, and SECO SB 5 initiatives;
- Complete the analysis of the stringency of several residential and commercial energy codes, including ASHRAE Standard 90.1-2004, and the 2006 IECC; and
- With the assistance of the TCEQ and EPA, expand all analysis to include all counties in Texas.

The Laboratory has and will continue to provide leading-edge technical assistance to counties and communities working toward obtaining full SIP credit for the energy efficiency and renewable energy projects that are lowering emissions and improving the air for all Texans. The Laboratory will continue to provide superior technology to the State of Texas through efforts with the TCEQ and US EPA. The efforts taken by the Laboratory have produced significant success in bringing EE/RE closer to US EPA acceptance in the SIP.

If any questions arise, please contact us by phone at 979-862-2804 or by email at [SB5info@esl.tamu.edu](mailto:SB5info@esl.tamu.edu).